

科目：有機化學(1002)

校系所組：中央大學化學學系

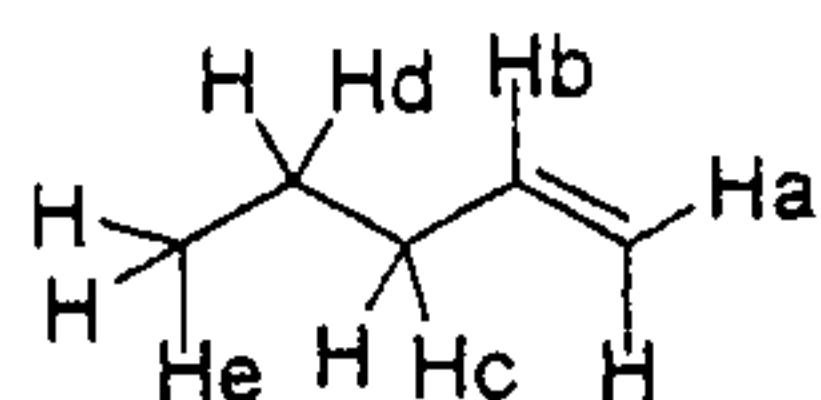
交通大學應用化學系(甲組)

清華大學化學系

清華大學材料科學工程學系(丙組)

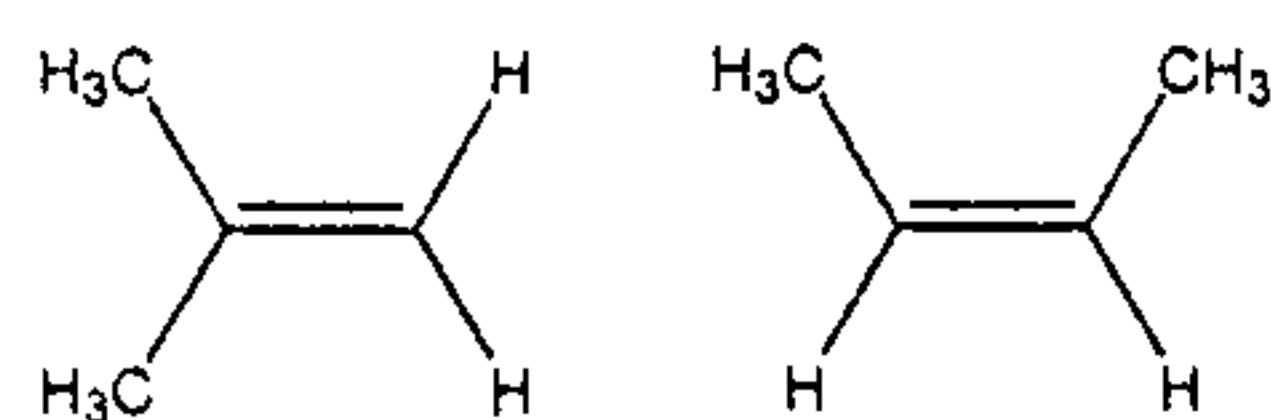
選擇題(單選，每題 2 分，總共 100 分)

- Which of the following pairs of bases lists the stronger base first?  
(A)  $\Gamma^- > \text{Cl}^-$ . (B)  $\text{H}_2\text{O} > \text{HO}^-$ . (C)  $\text{HO}^- > \text{H}_2\text{N}^-$ . (D)  $\text{CH}_3\text{COO}^- > \text{HO}^-$ . (E)  $\text{H}_2\text{N}^- > \text{CH}_3\text{COO}^-$ .
- Triethylamine  $[(\text{CH}_3\text{CH}_2)_3\text{N}]$  is a molecule in which the nitrogen atom is \_\_\_\_\_ hybridized and the CNC bond angle is \_\_\_\_\_.  
(A)  $\text{sp}^2, > 109.5^\circ$ . (B)  $\text{sp}^2, < 109.5^\circ$ . (C)  $\text{sp}^3, > 109.5^\circ$ . (D)  $\text{sp}^3, < 109.5^\circ$ . (E)  $\text{sp}, 109.5^\circ$ .
- Which H atom in the molecule shown will be most readily abstracted by a bromine radical?  
(A) Ha. (B) Hb. (C) Hc. (D) Hd. (E) He.

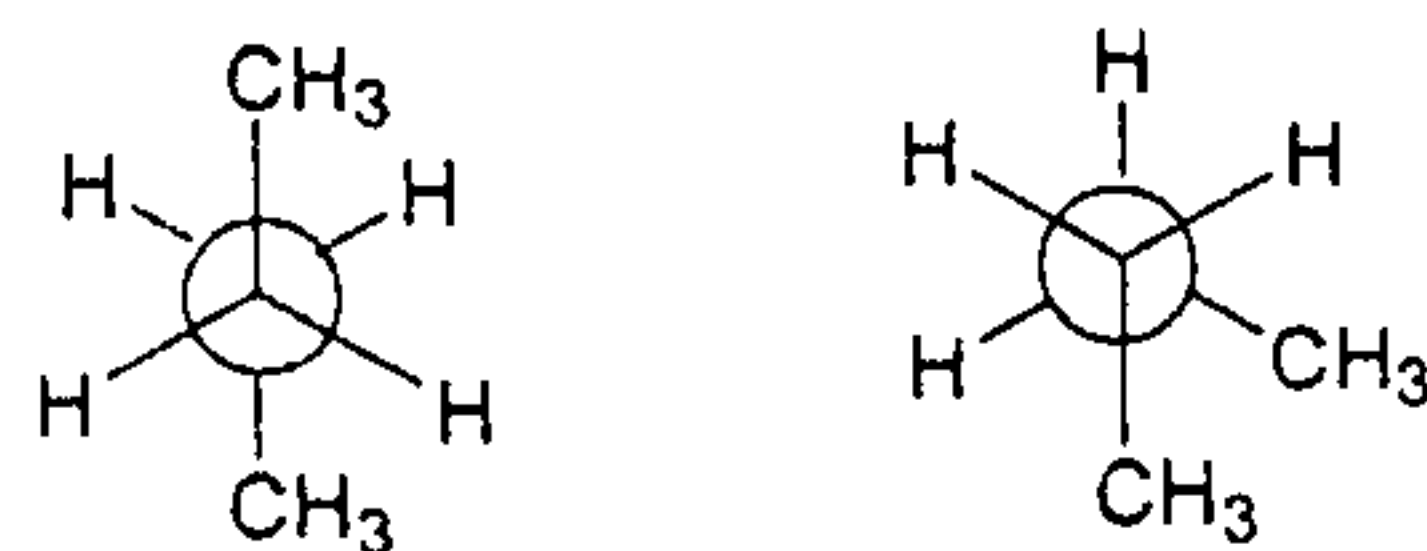


- Which of the following reactive intermediates can best be described as both a nucleophile and an electrophile?  
(A) Carbanions. (B) Carbocations. (C) Carbenes. (D) Free radicals. (E) Alkanes.

- Are the compounds shown below best described as?



- (A) Cis-trans isomers. (B) Constitutional isomers. (C) Not isomers. (D) Geometrical isomers. (E) None of the above.
- Which functional groups below indicates the presence of two atoms connected by a triple bond?  
(A) Alkyne. (B) Alkene. (C) Nitrile. (D) Ester. (E) Both A and C.
- The structures below are:



- (A) Geometrical isomers.  
(B) Conformational isomers.  
(C) Constitutional isomers.  
(D) Structural isomers.  
(E) Both (A) and (D).
- Which of the following reagents will react with propene to give 2-propanol?  
(A)  $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$  (B)  $\text{Hg}(\text{OAc})_2, \text{MeOH}; \text{NaBH}_4$  (C)  $\text{BH}_3 \cdot \text{THF}; \text{H}_2\text{O}_2, \text{OH}^-$  (D)  $\text{H}_2/\text{Pt}$  (E)  $\text{Br}_2/\text{H}_2\text{O}$ .
- Which of the following reagents can be used to prepare epoxide from alkenes?  
(A) MCPBA in methylene chloride. (B) Peroxyformic acid in water. (C) Formic acid in water. (D) Peroxybenzoic acid in sodium hydroxide. (E) Peroxyacetic acid in water.

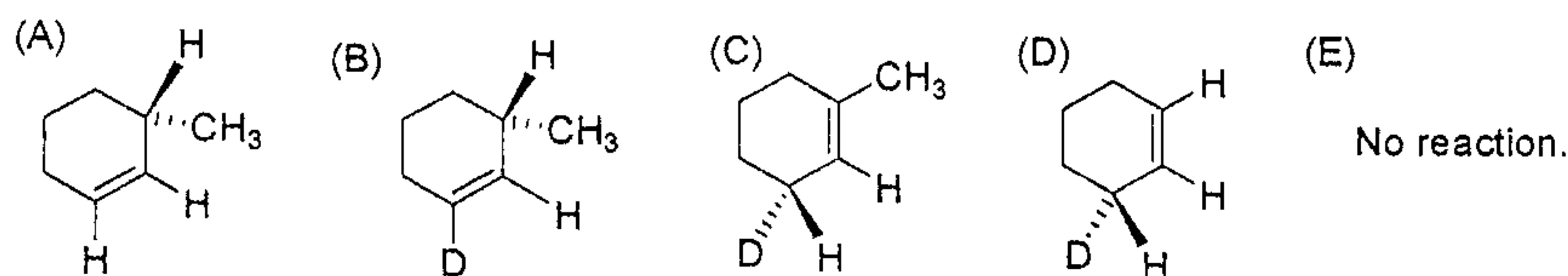
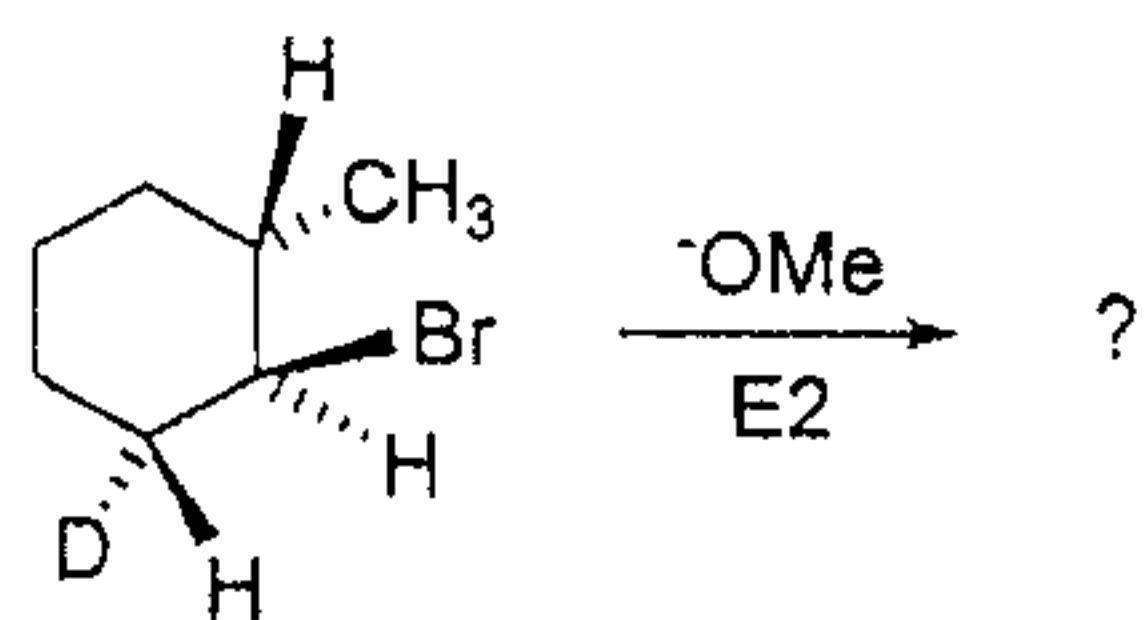
參考用

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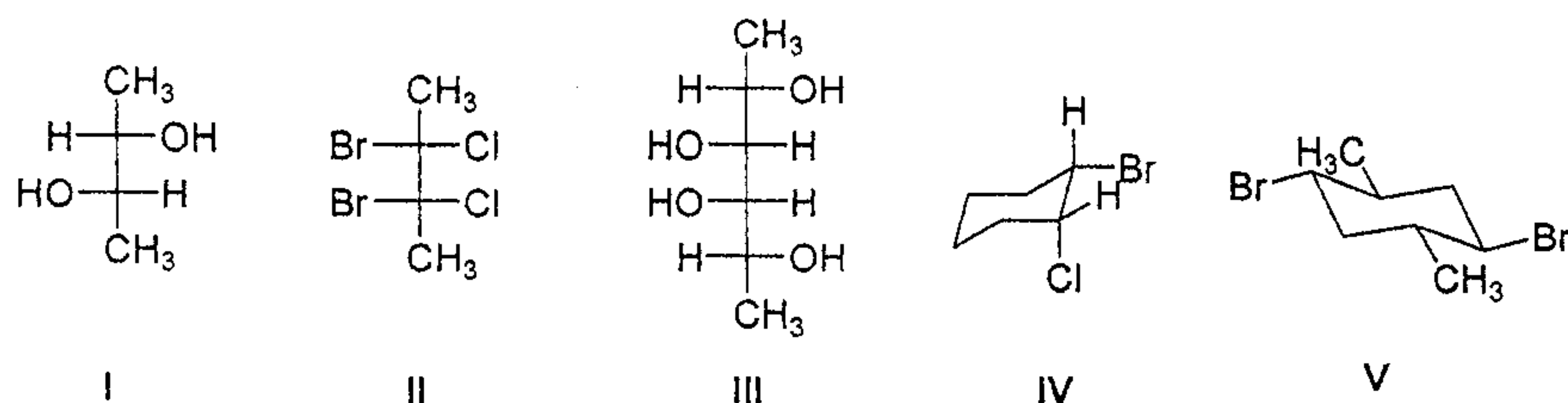
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- 10). Which of the following best describes DDT?
- (A) A chlorocarbon used to decaffeinate coffee beans.  
 (B) A polybrominated organic compound used as a herbicide.  
 (C) A polychlorinated organic compound used as an insecticide.  
 (D) Mixed alkyl halides used as an anesthetic.  
 (E) Freon used as a foaming agent.
- 11). S<sub>N</sub>2 reactions usually proceed with:
- (A) Equal amounts of inversion and retention at the center undergoing substitution.  
 (B) Slightly more inversion than retention at the center undergoing substitution.  
 (C) Slightly more retention than inversion at the center undergoing substitution.  
 (D) Complete inversion at the center undergoing substitution.  
 (E) Complete retention at the center undergoing substitution.
- 12). Which of the following alkyl halides can produce only a single alkene product when treated with sodium methoxide?
- (A) 2-chloro-2-methylpentane.  
 (B) 3-chloro-3-ethylpentane.  
 (C) 3-chloro-2-methylpentane.  
 (D) 2-chloro-4-methylpentane.  
 (E) 2-chloro-3-ethylpentane.
- 13). What would be the reaction product(s) from the following E2 reaction?



- 14). Which of the following compounds are chiral?



- (A) I only.  
 (B) II and III.  
 (C) III and IV.  
 (D) I and IV.  
 (E) V only.

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- 15). Which of the following solvents could be described as polar aprotic? (I) ethanol, (II) acetonitrile, (III) dimethylformamide, (IV) THF, and (V) diethyl ether.
- (A) I only.  
(B) II and III.  
(C) III only  
(D) I and III.  
(E) III and V.
- 16). Which of the following alcohols is **not** likely to yield a product where skeletal rearrangement occurred when treated with sulfuric acid?
- (A) 3-methyl-3-pentanol.  
(B) 3,3-dimethyl-2-butanol.  
(C) 2,2-dimethylcyclohexanol.  
(D) cyclopentylmethyl alcohol.  
(E) 2,3-dimethyl-butan-2,3-diol.
- 17). If a mixture contains 75% of one compound and 25% of its enantiomer, what is the e.e. of the mixture?
- (A) 100.  
(B) 75.  
(C) 50.  
(D) 25.  
(E) 3.
- 18). Rank the following species in order of decreasing acid-dissociation constant: methanol (I), ethanol (II), 2-chloroethanol (III), *t*-butyl alcohol (IV), and phenol (V).
- (A) V > IV > III > II > I  
(B) V > III > I > II > IV  
(C) III > V > I > IV > II  
(D) V > I > III > II > IV  
(E) III > IV > V > II > I
- 19). Which of the following compounds can be reduced by  $\text{LiAlH}_4$  to form primary alcohol?
- (I) aldehyde, (II) ketone, (III) alkene, (IV) acid, (V) acetylene.
- (A) I only.  
(B) II only.  
(C) I and II.  
(D) I and IV.  
(E) IV only.
- 20). Which of the following statements about the heats of combustion of acetylene, ethene, and ethane is incorrect?
- (A) Acetylene is the best high-temperature flame.  
(B) Acetylene release the most heat per mole of gas consumed.  
(C) Ethene produced the most heat per mole of gas consumed.  
(D) Acetylene produced the most heat per mole of products formed.  
(E) The oxyacetylene flame reaches temperatures as high as 2800 °C.

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21). Which of the following methods can prepare aldehyde in high yield from primary alcohol?

- (A) Br<sub>2</sub>, H<sub>2</sub>O.
- (B) DMSO, (COCl)<sub>2</sub>, NEt<sub>3</sub>/CH<sub>2</sub>Cl<sub>2</sub>.
- (C) DIBAH.
- (D) KMnO<sub>4</sub>, HO<sup>-</sup>.
- (E) LiAlH<sub>4</sub>.

22). Which of the following statements about Lucas test is correct?

- (A) The reagent composed of HCl and ZnI<sub>2</sub>
- (B) Tertiary alcohols react faster than primary alcohol
- (C) Primary alcohols react by the S<sub>N</sub>1 mechanism
- (D) Primary alcohols react faster than tertiary alcohols.
- (E) Tertiary alcohols react by the S<sub>N</sub>2 mechanism.

23). Which of the species below is/are more basic than acetylide?

- (I) CH<sub>3</sub>Li, (II) CH<sub>3</sub>ONa, (III) CH<sub>3</sub>MgBr, (IV) NaOH, (V) LAH.
- (A) I only.
- (B) II only.
- (C) III only.
- (D) I and III.
- (E) II and IV.

24). Which of the following compound(s) would be expected to show intense IR absorption at 3300 cm<sup>-1</sup>?

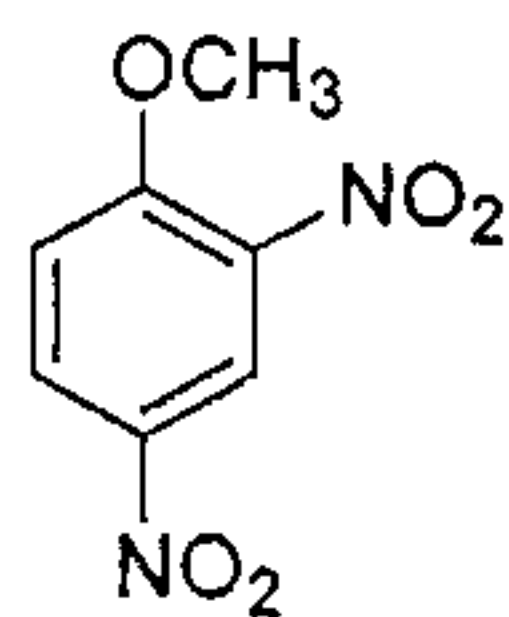
- (I) CH<sub>3</sub>C ≡ CCH<sub>3</sub>, (II) butane, (III) but-1-ene, (IV) CH<sub>3</sub>CH<sub>2</sub>C ≡ CH, and (V) diethyl amine.
- (A) I and III.
- (B) III only.
- (C) IV only.
- (D) IV and V.
- (E) I, IV, and V.

25). What splitting pattern is observed in the proton NMR spectrum for the underlined hydrogens?

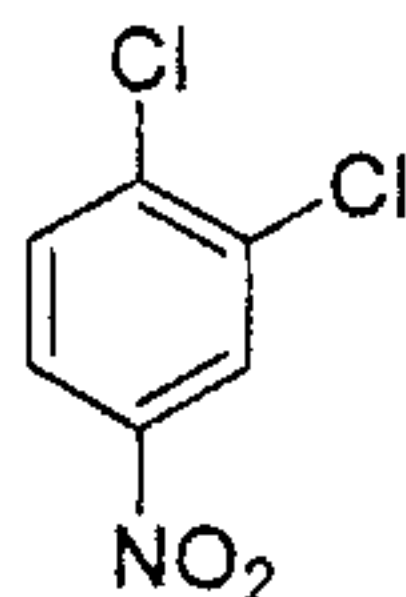


- (A) Singlet.
- (B) Doublet.
- (C) Triplet.
- (D) Quartet.
- (E) Septet.

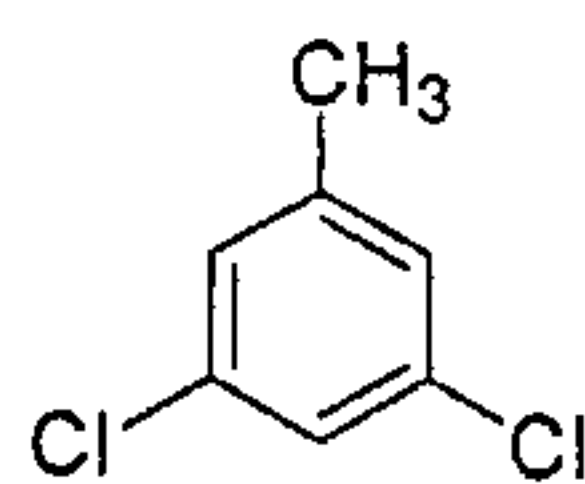
26). Which of the following compounds can probably be prepared by direct electrophilic substitution on a disubstituted benzene?



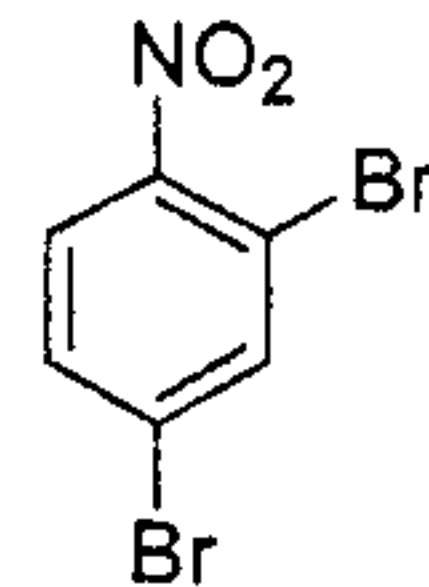
(I)



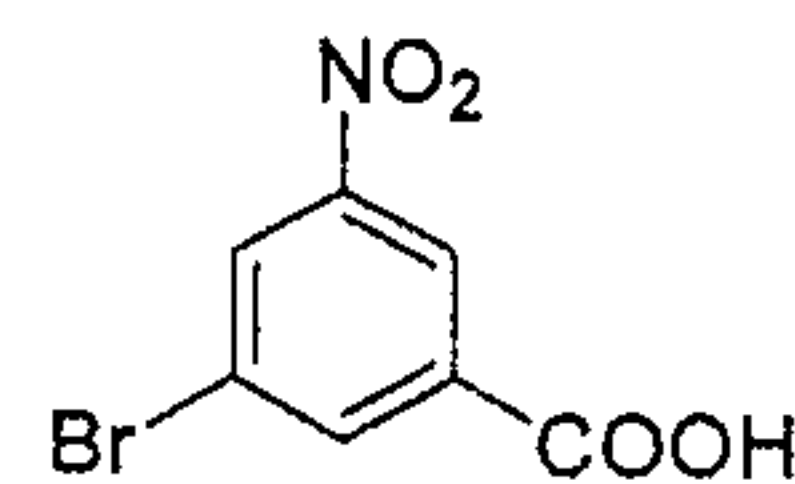
(II)



(III)



(IV)

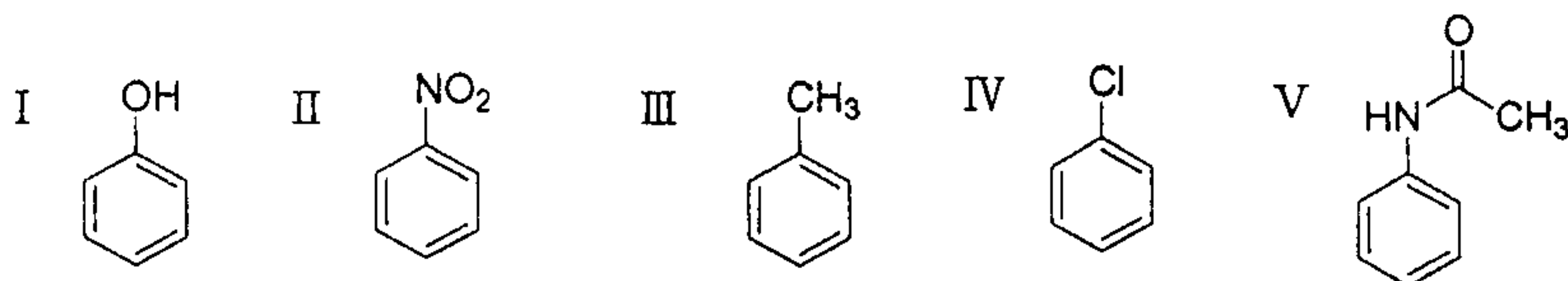


(V)

- (A) I, II, III, IV
- (B) I, II, IV, V
- (C) I, III, V
- (D) I, III.
- (E) I, II, III, IV, V.

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27). Which of the above compounds would undergo electrophilic nitration most rapidly?

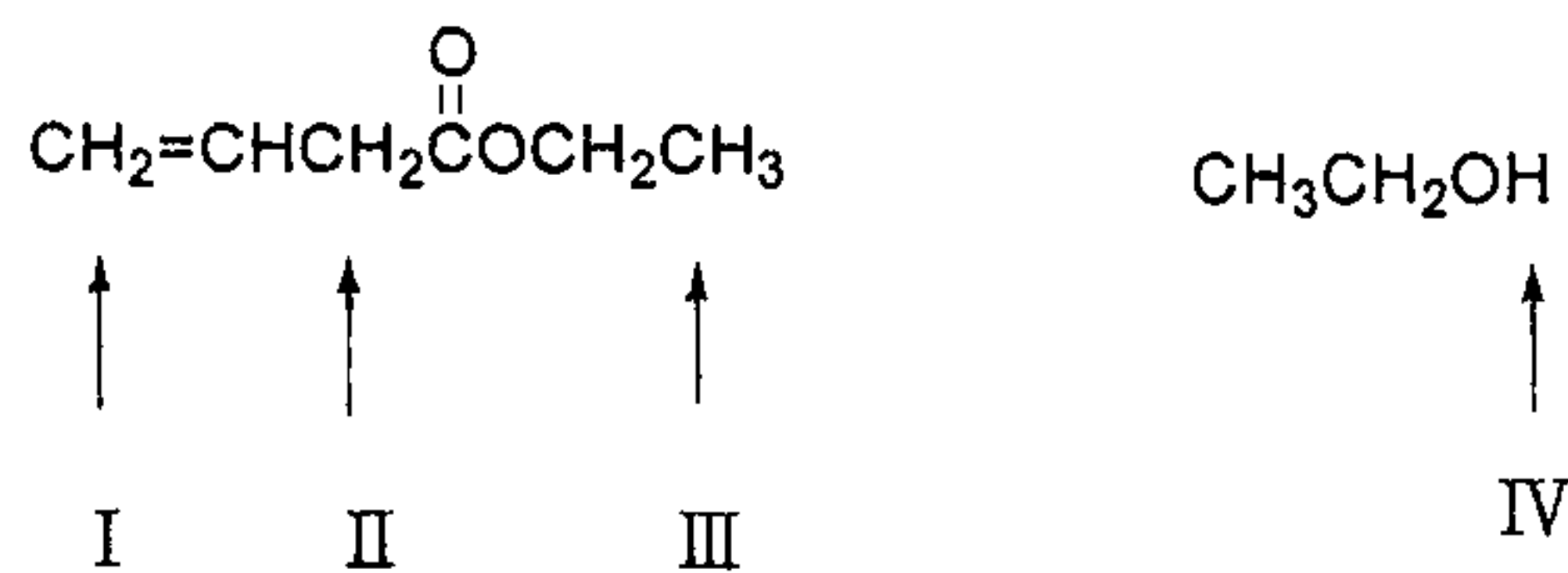
- (A) I  
(B) II  
(C) III  
(D) IV  
(E) V

28). Which of the above compounds would give predominantly a mixture of *ortho* and *para* nitration products?

- (A) I, II, V  
(B) II, III  
(C) I, III, IV, V  
(D) IV, V  
(E) None

29). Which of the following statements concerning resonance and inductive effects is *false*?

- (A)  $\pi$ -bond is generally involved in resonance.  
(B) Inductive effect normally goes through  $\sigma$ -bond.  
(C)  $\text{CH}_3\text{O}$  group in  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CO}_2\text{H}$  is an electron-donating group.  
(D)  $\text{CH}_3\text{OCH}_2^+$  is more stable than  $\text{CH}_3\text{CH}_2^+$  because of resonance.  
(E) *m*-Methoxybenzoic acid is more acidic than benzoic acid because of inductive effect.

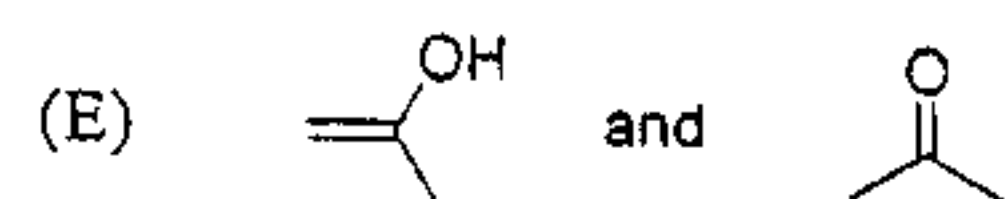
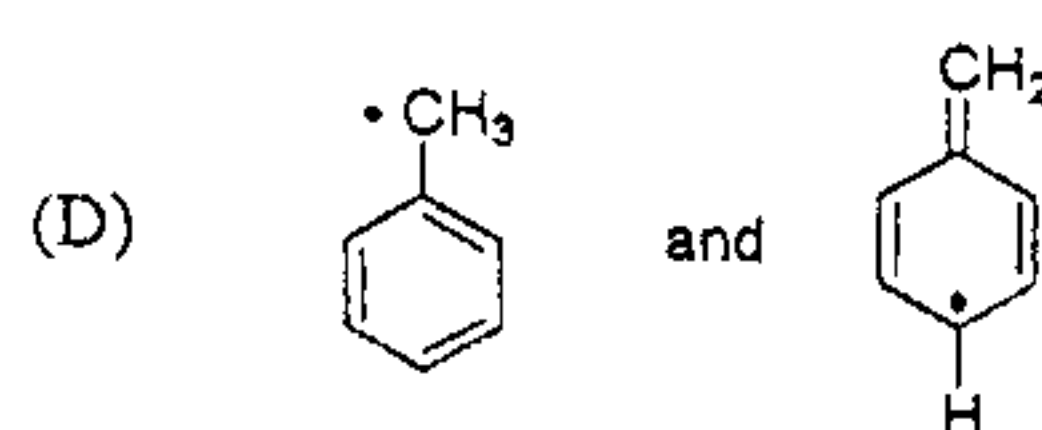
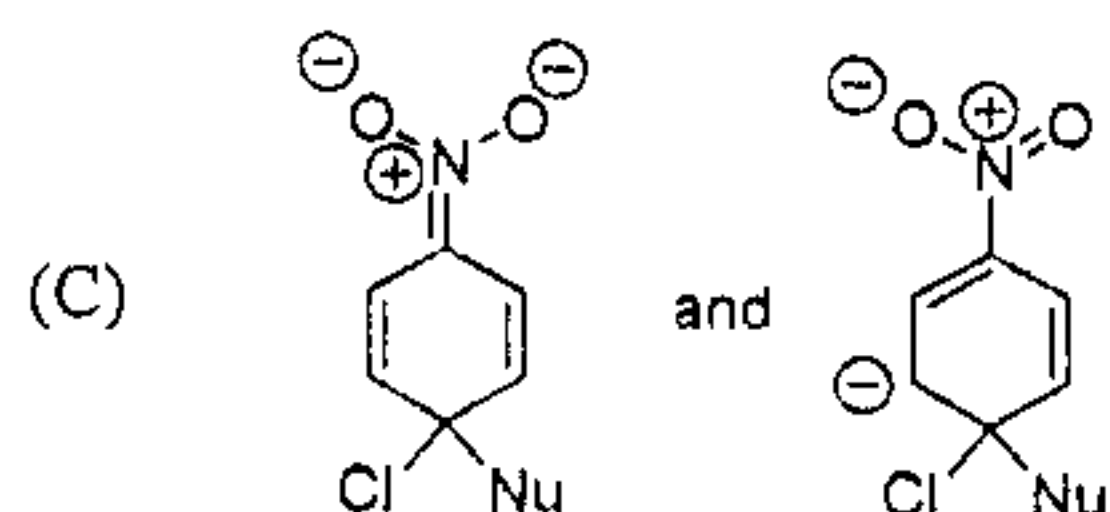
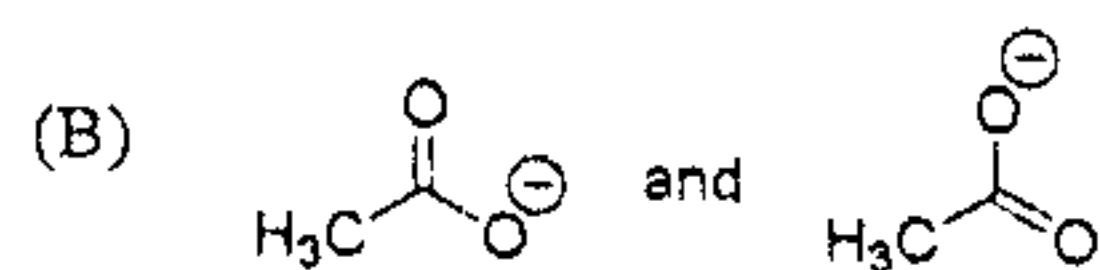
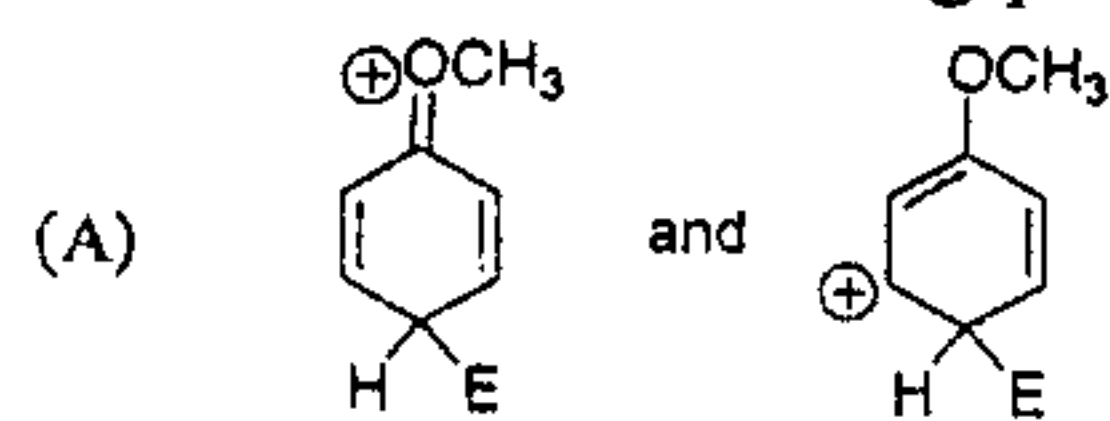
30). Arrange the indicated hydrogen in order of increasing acidity (*i.e.*, least acidic first).

- (A) I, III, IV, II  
(B) IV, II, I, III  
(C) I, III, II, IV  
(D) III, I, II, IV  
(E) None of the above.

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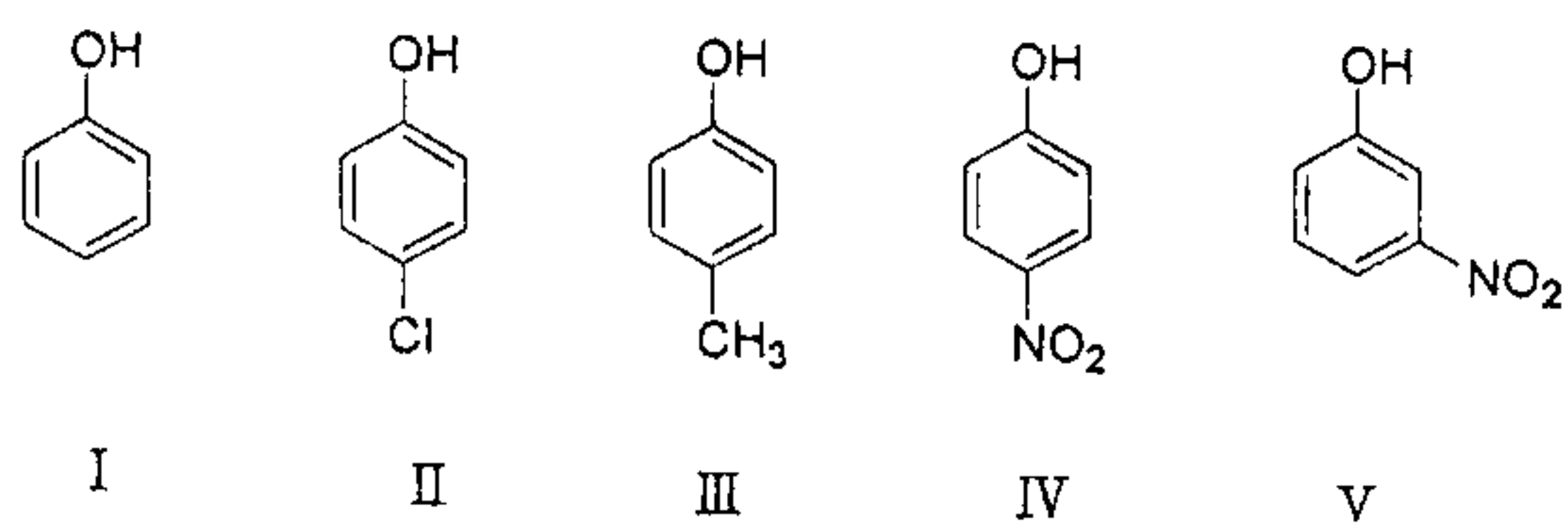
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31). Which of the following pairs is *not* resonance structure?



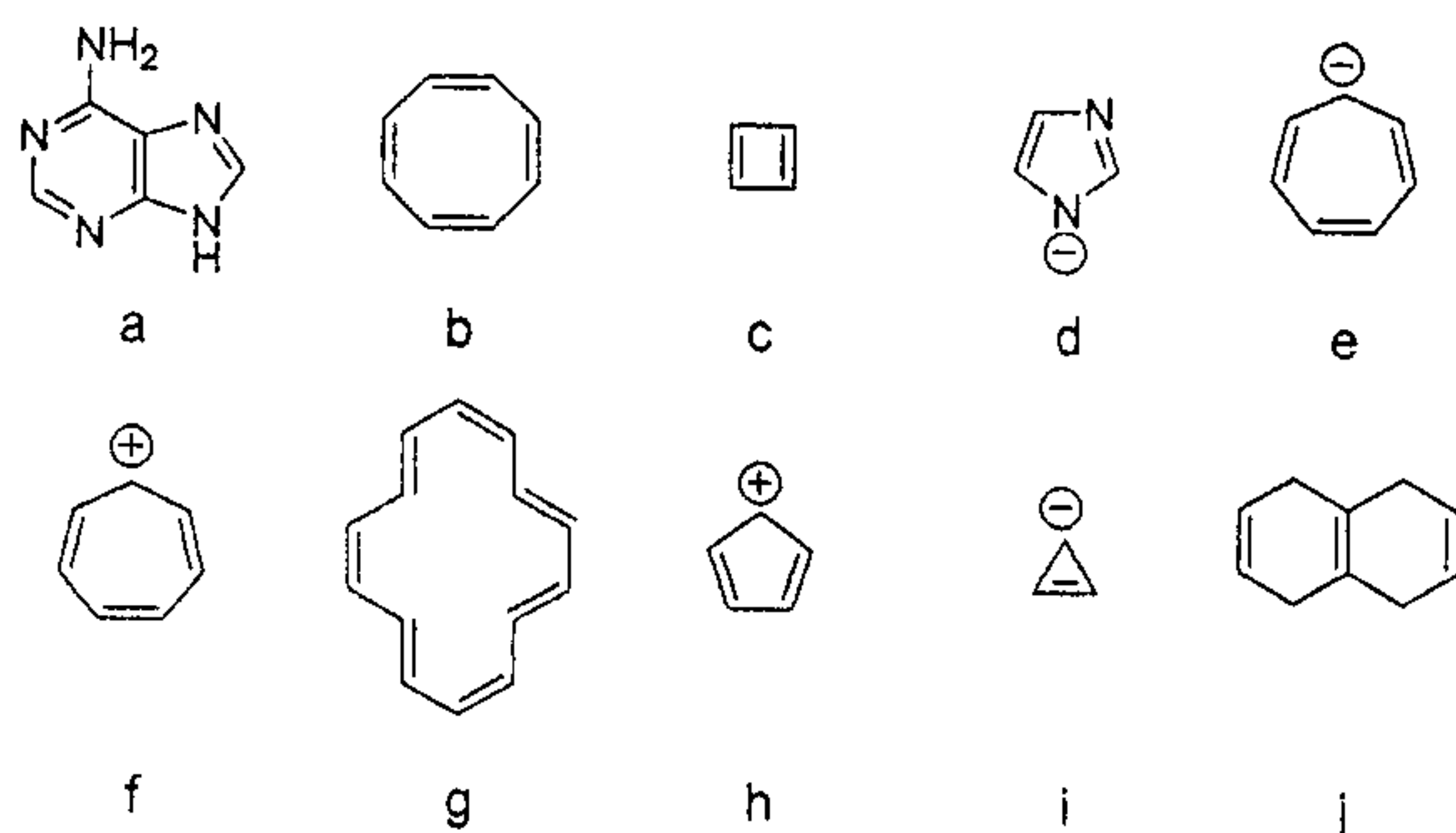
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32). Arrange the following in order of increasing acidity (*i.e.*, least acidic first).



- (A) III, I, II, V, IV  
 (B) I, II, III, IV, V  
 (C) V, IV, III, II, I  
 (D) V, IV, II, I, III  
 (E) I, IV, II, III, V

33). Which of the following molecules are aromatic compounds?

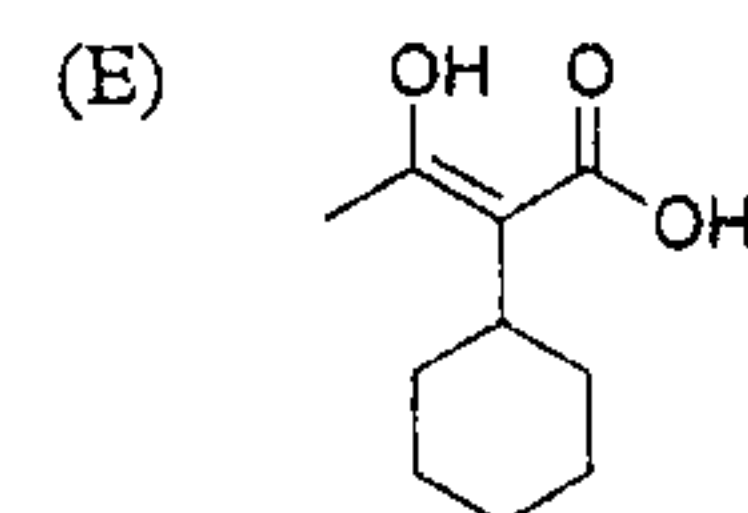
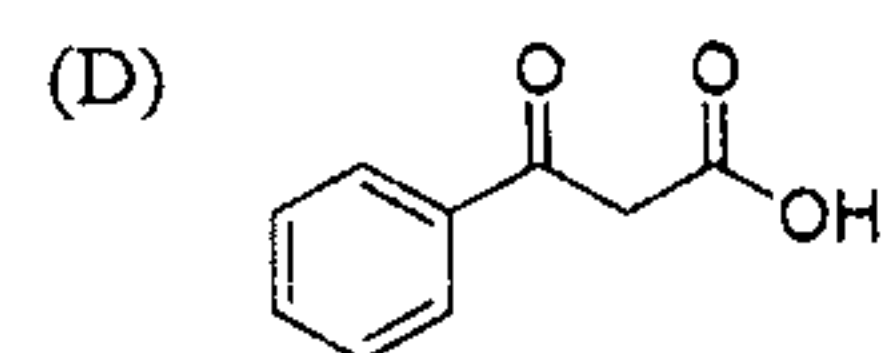
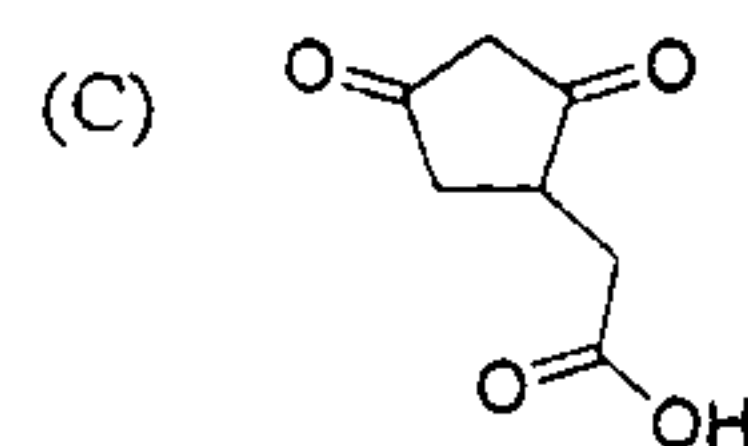
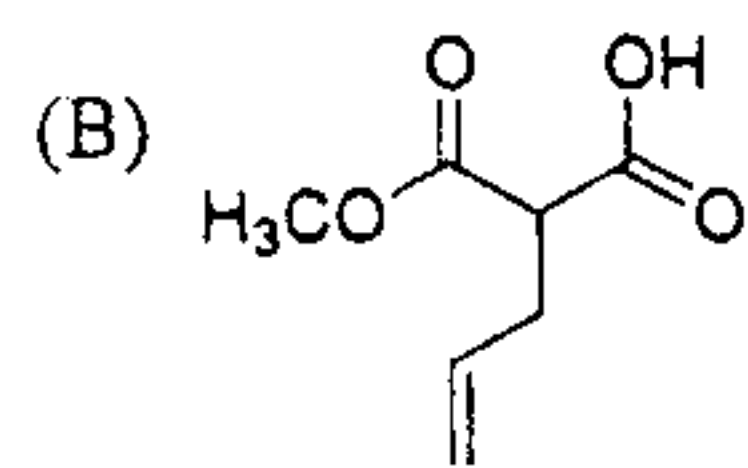
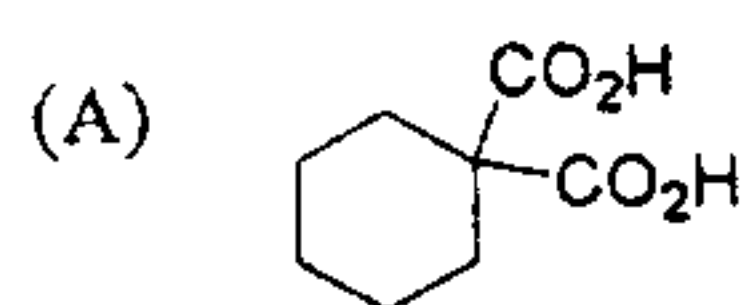


- (A) a, d, f, g, j  
 (B) c, e, h, i  
 (C) b, g, j  
 (D) b, j  
 (E) a, d, f, g

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34). Which of the following would *not* readily undergo decarboxylation?

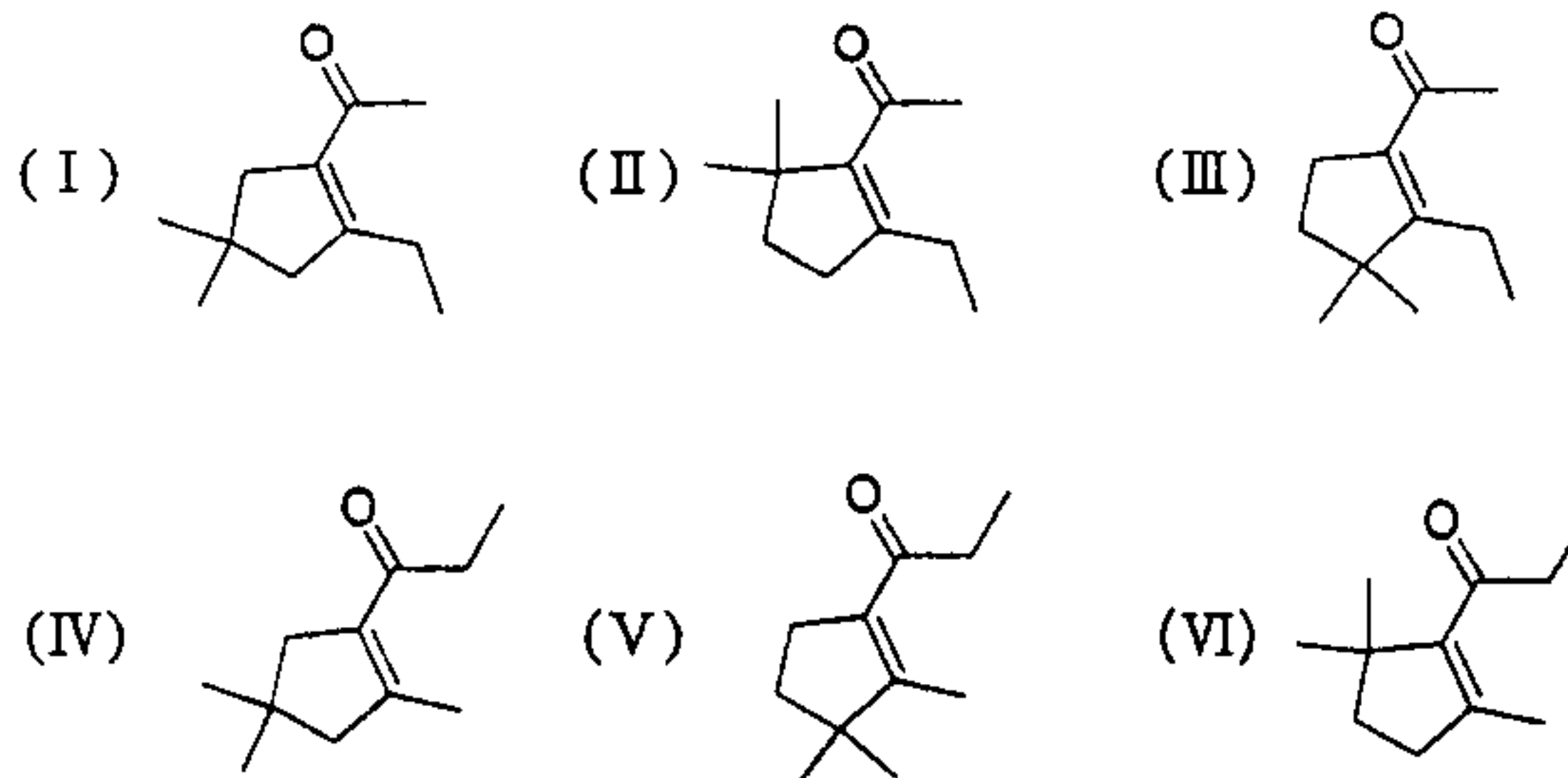
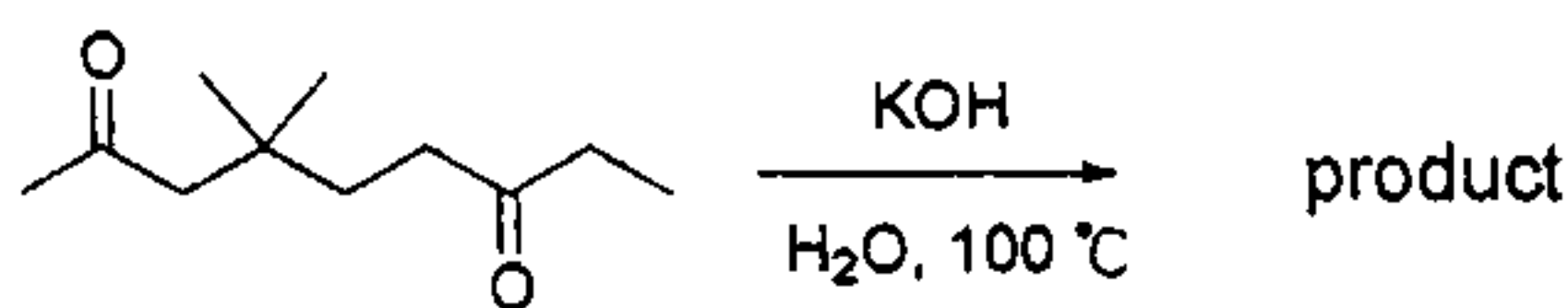


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35). Which of the following statements is *false*?

- (A) 2-Bromoethan-1-ol is more acidic than 2-chloroethan-1-ol due to inductive effect.
- (B) *para*-Methoxybenzoic acid is more acidic than *para*-cyanobenzoic acid due to resonance effect.
- (C) Aldol condensation reaction can be catalyzed in acidic or in basic condition.
- (D) Carbon-carbon double bond hydrogenation reaction using the catalyst, Pt on charcoal, gives the *cis*-addition product.
- (E) The  $K^+$  ion can be captured more efficiency than  $Na^+$  ion by 18-crown-6 ether.

36). Which of the following product(s) can be formed from the reaction below?



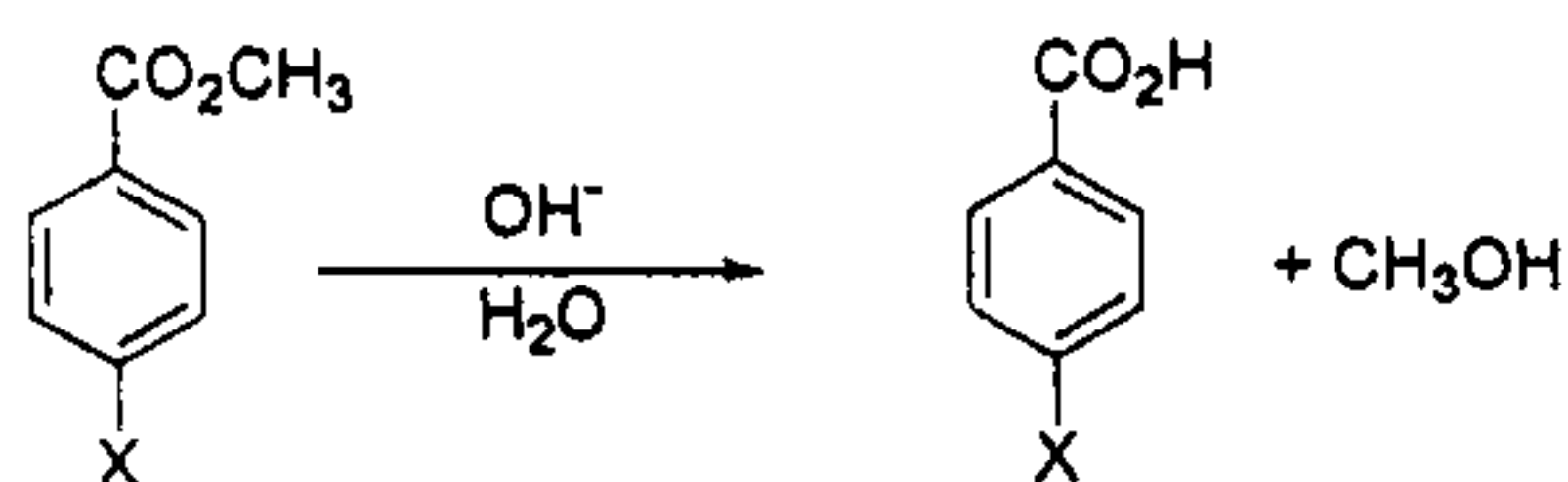
- (A) I, IV
- (B) I, II, V, VI
- (C) III, VI
- (D) II, IV
- (E) II, III, IV, V

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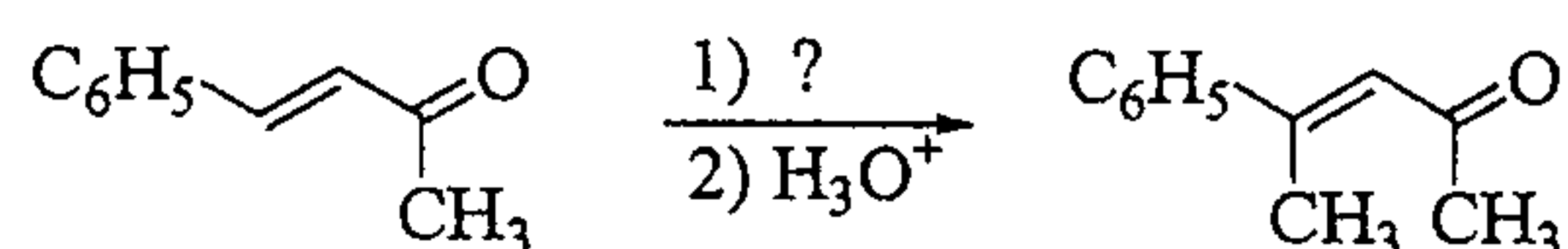
37). The hydrolysis of an aromatic ester can readily occur upon treatment with NaOH in H<sub>2</sub>O. The rate of the reaction depends on the electrophilicity of the carbonyl carbon. Which of the following substrates react at the fastest rate?



- (A) X = NO<sub>2</sub>
- (B) X = Cl
- (C) X = H
- (D) X = CH<sub>3</sub>
- (E) X = CH<sub>3</sub>O.

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38). Which of the following reagents would be best for the reaction shown above?

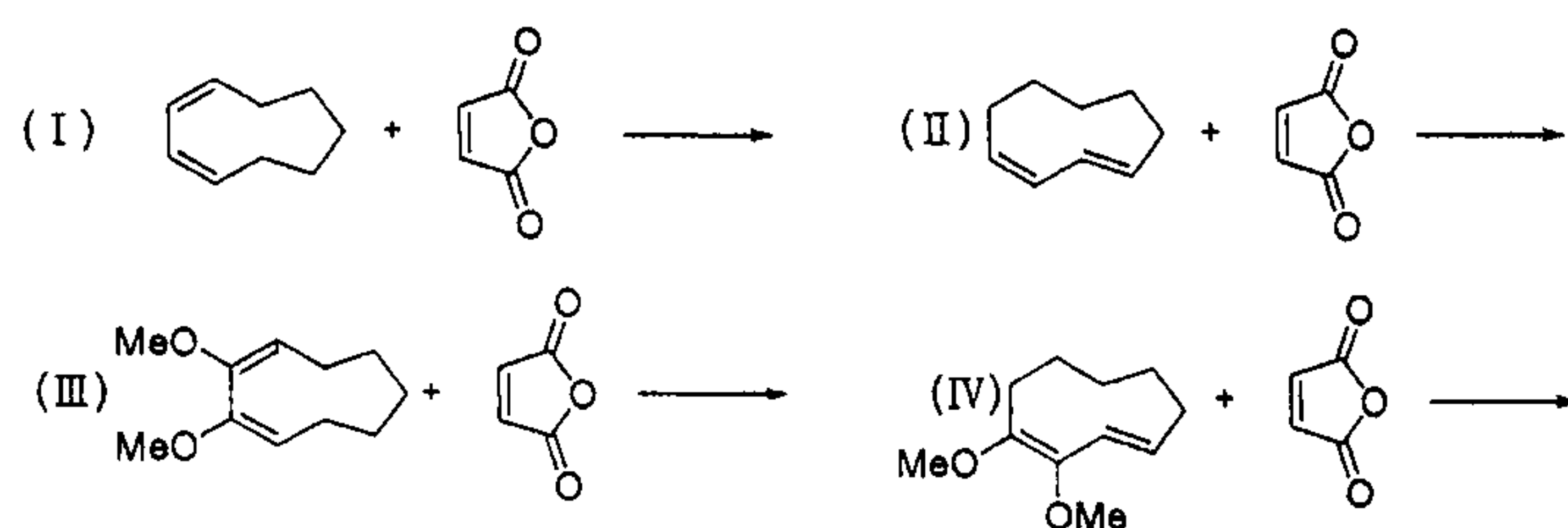


- (A) CH<sub>3</sub>MgCl
- (B) CH<sub>3</sub>I
- (C) CH<sub>3</sub>Li
- (D) CH<sub>3</sub>MgBr
- (E) (CH<sub>3</sub>)<sub>2</sub>CuLi

39). Which of the following compounds exhibits absorption at the longest wavelength in the UV region?

- (A) 3-phenylpropene
- (B) 2-phenylpropene
- (C) benzene
- (D) *n*-propylbenzene
- (E) isopropylbenzene.

Use the following reactions to answer questions 40 and 41:



40). Which of the Diels-Alder reactions above *can not* proceed?

- (A) I, III
- (B) I, II
- (C) III, IV
- (D) II, IV
- (E) II, III, IV

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41). Which of the Diels-Alder reaction above occurs most rapidly?

- (A) I
- (B) II
- (C) III
- (D) IV
- (E) V

42). Which of the following descriptions are *not* true for amine chemistry.

- (I) Nitration of pyridine occurs at 4-position.
- (II) Gabriel synthesis is developed for making secondary amines.
- (III) Isocyanate is an intermediate of Hofmann rearrangement.
- (IV) Piperidine is a stronger base than pyridine
- (V) Reaction of an amide with lithium aluminum hydride affords a primary alcohol

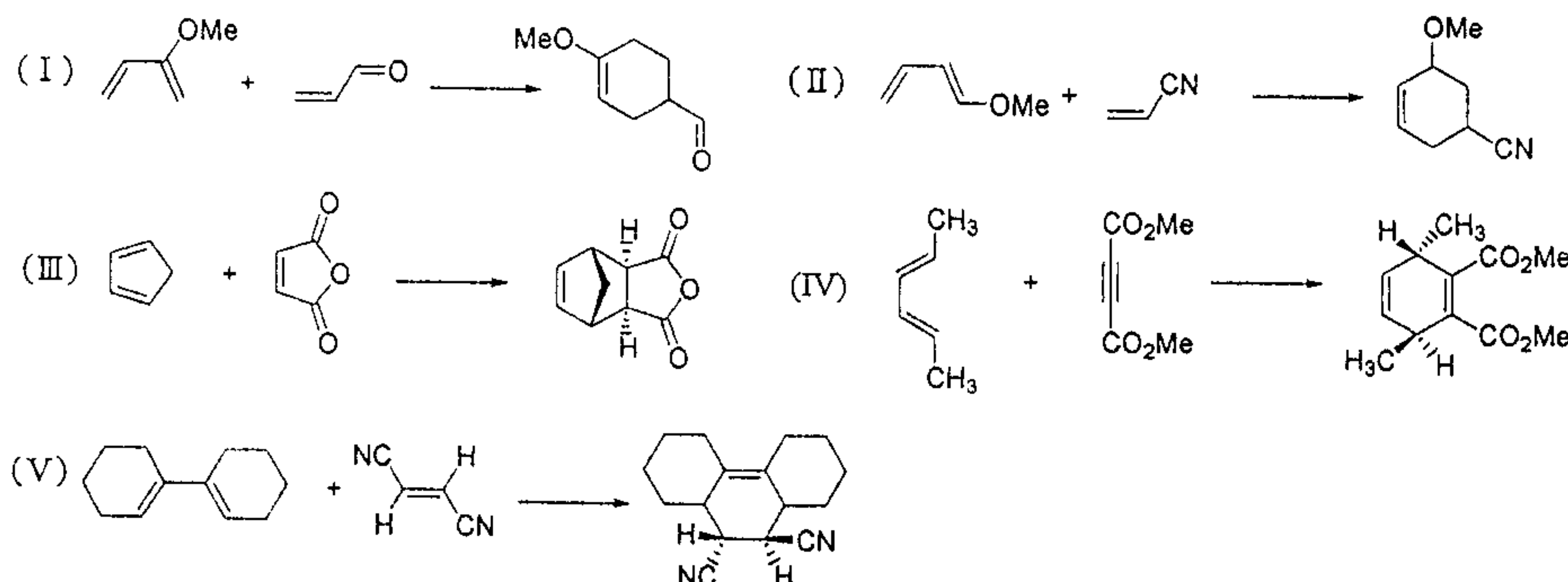
- (A) I, II, V
- (B) II, III, IV
- (C) I, III, V
- (D) II, IV, V
- (E) I, III, IV

43). Which of the following descriptions are *not* true for carbonyl chemistry.

- (I) The side product of Wittig reaction is phosphine oxide.
- (II) Amides can be formed by reacting carboxylic acids with diazomethane.
- (III) Wolff-Kishner reduction is carried out under basic condition
- (IV) Acetals are hydrolyzed under basic condition and stable under acidic condition.
- (V) Friedel-Crafts alkylation is limited by multiple substitutions.

- (A) II, III
- (B) II, IV
- (C) I, III
- (D) IV, V
- (E) III, IV.

44). Which of the following Diels-Alder reactions give the major product with the correct stereochemistry or regioselectivity?

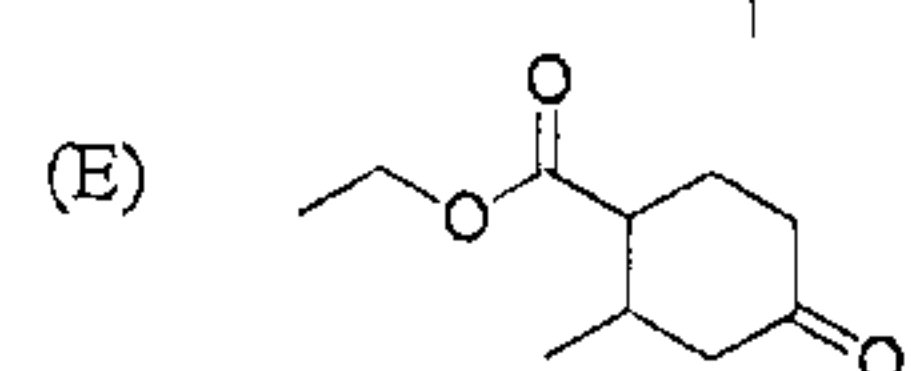
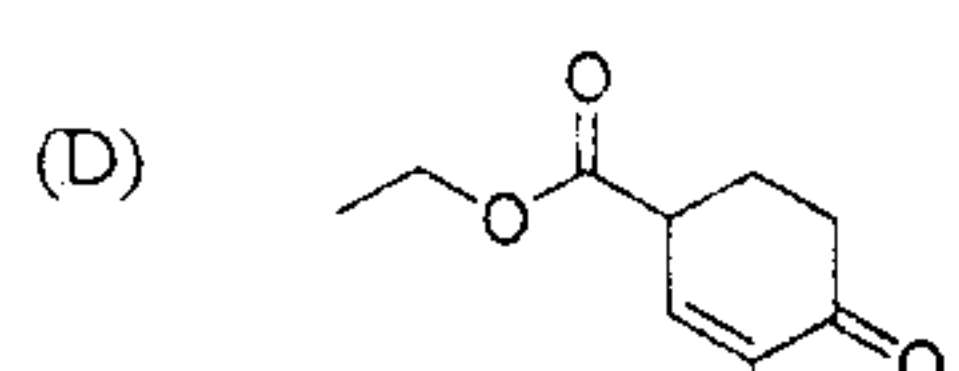
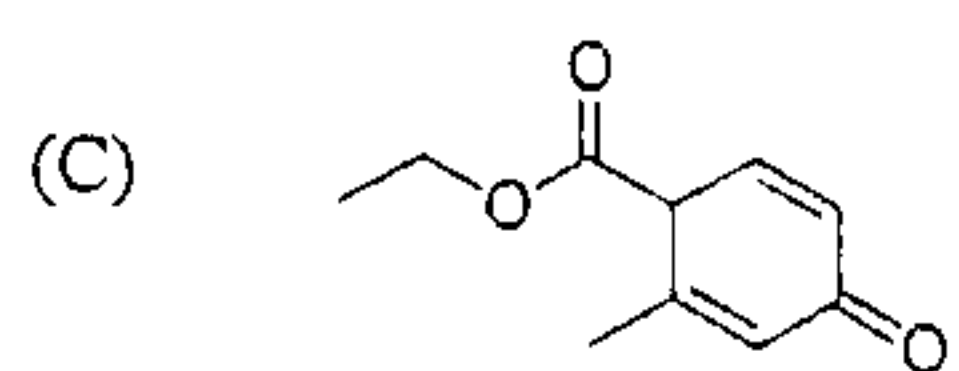
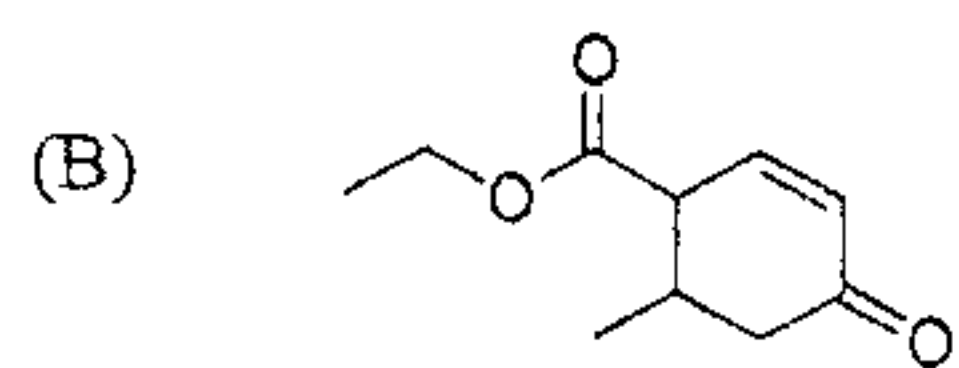
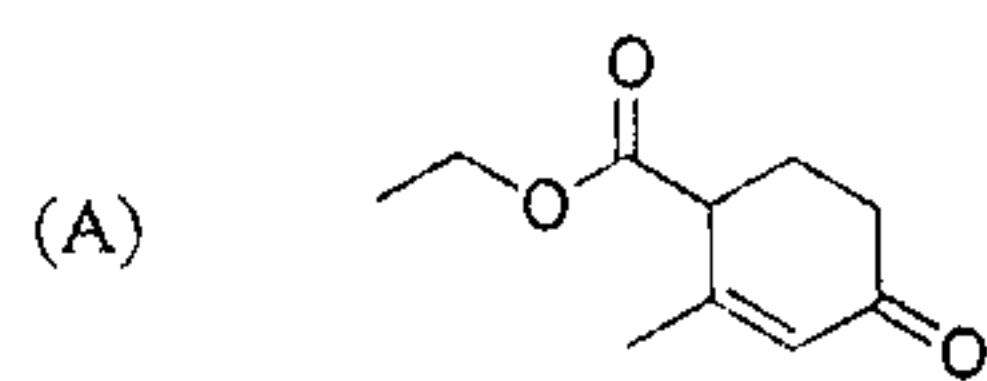
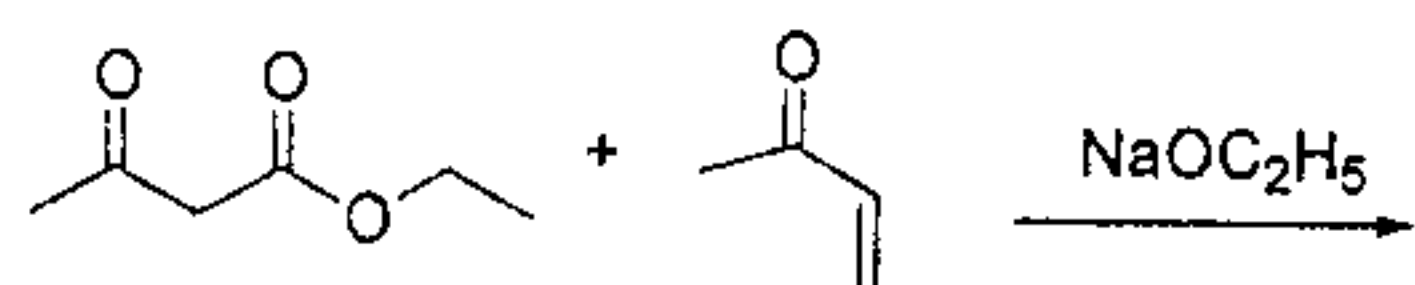


- (A) I, II, III
- (B) I, III, IV
- (C) III, IV, V
- (D) I, II, III, V
- (E) I, V

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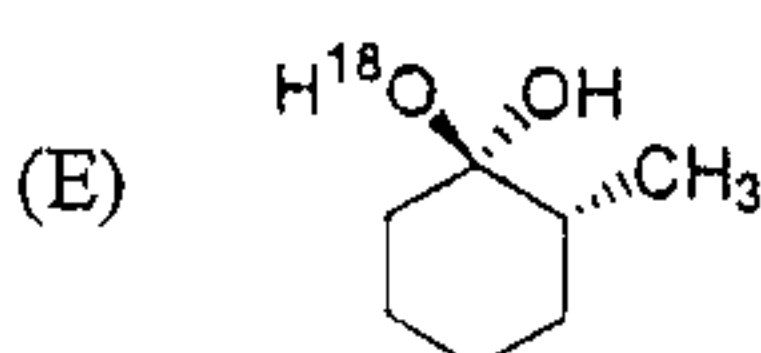
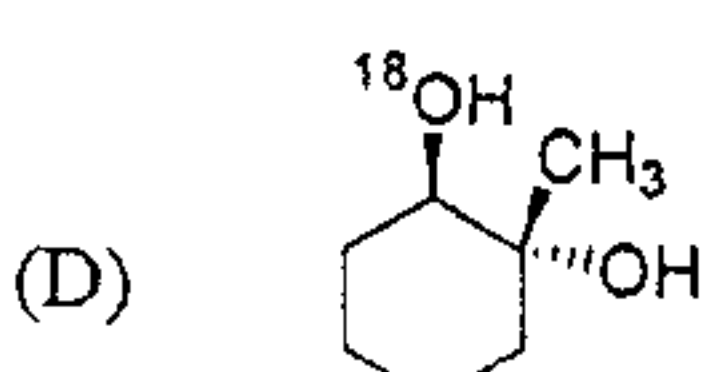
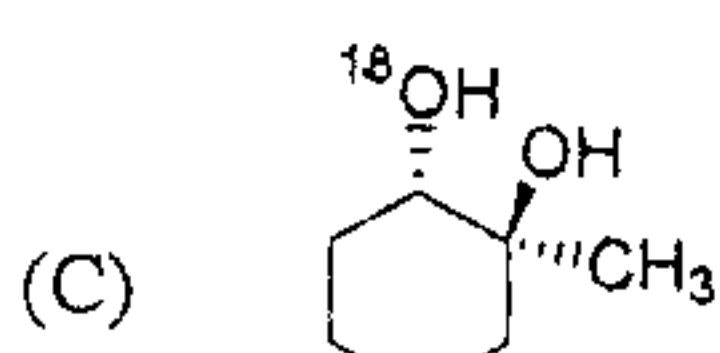
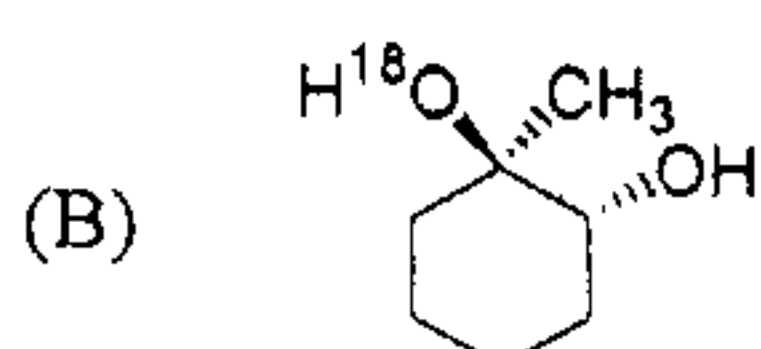
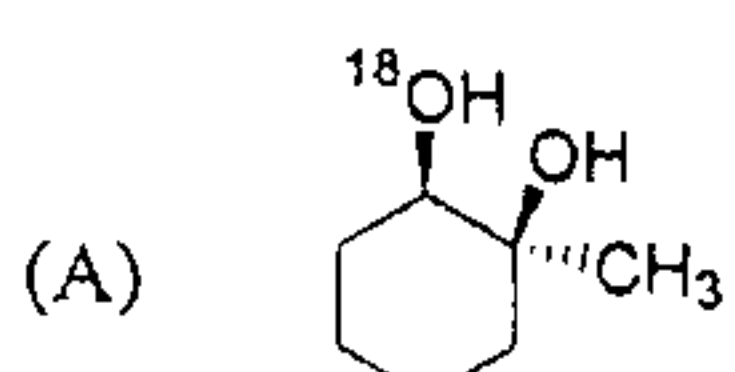
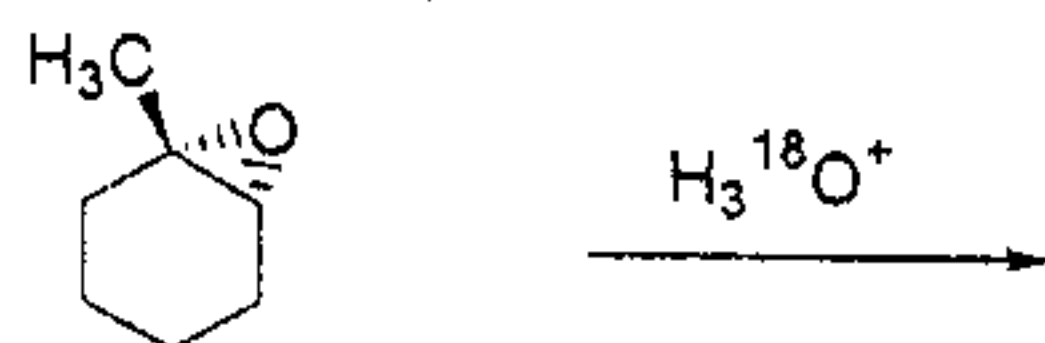
科目：有機化學(1002)

45). Which of the following products for the reaction is correct?

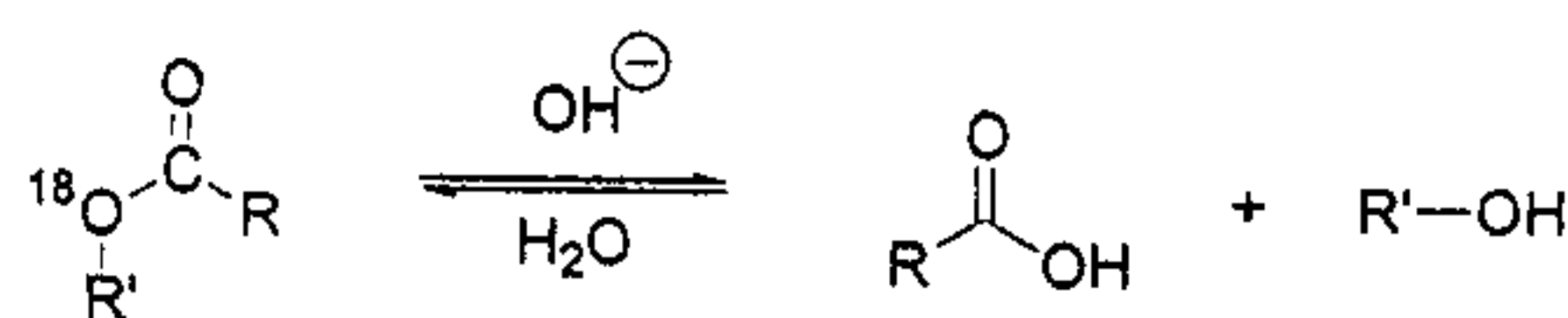


參考用

46). What is the major product from the following reaction?



47). When an  $^{18}\text{O}$ -labelled ester is treated with  $\text{NaOH}$  in  $\text{H}_2\text{O}$ , carboxylic acid and alcohol are isolated. Which of the following statements is *true*?



(A)  $^{18}\text{O}$  remains in both oxygen atoms of the carboxylic acid.

(B) The solvent water should contain  $^{18}\text{O}$ .

(C)  $^{18}\text{O}$  remains in the carbonyl oxygen only.

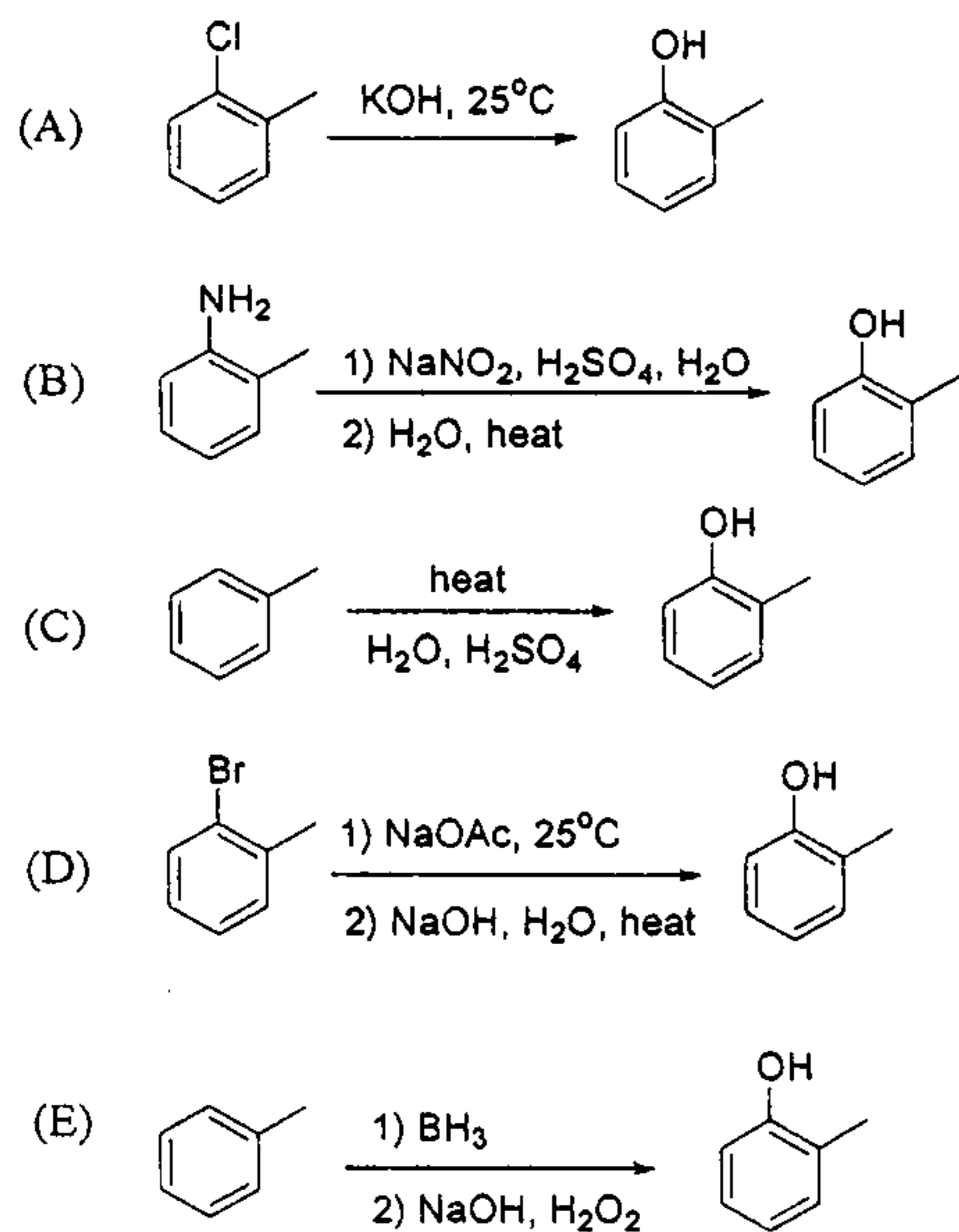
(D)  $^{18}\text{O}$  remains in alcohol only.

(E)  $^{18}\text{O}$  is found in both the carboxylic acid and the alcohol.

注意：背面有試題

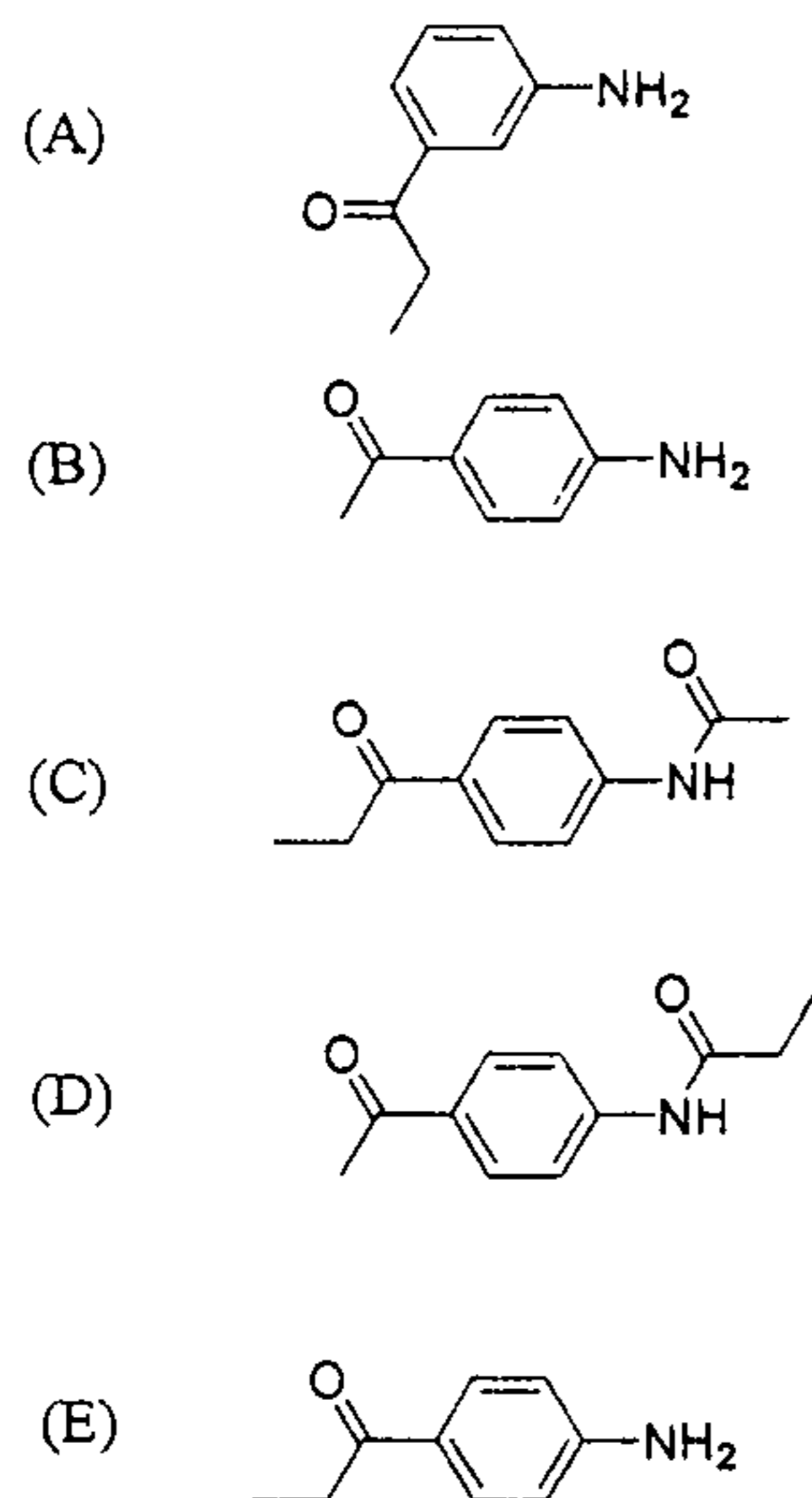
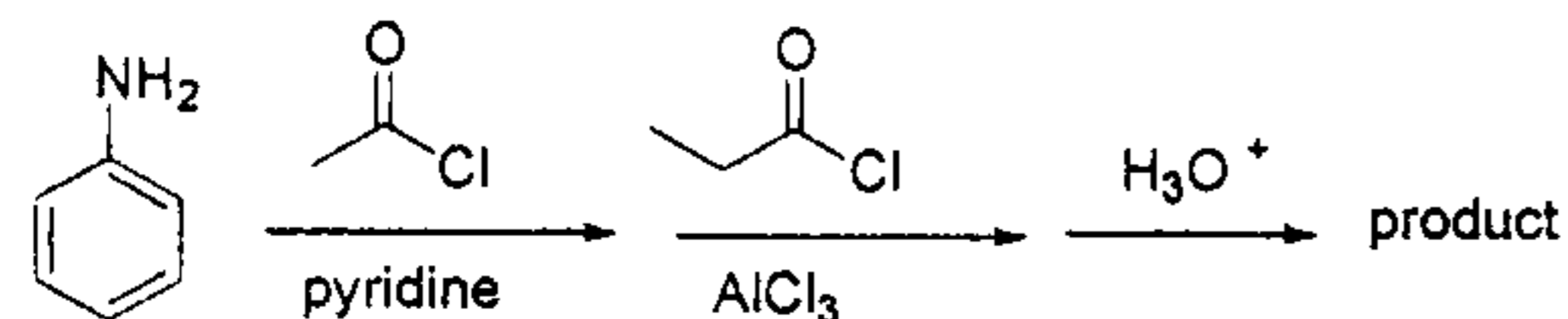
科目：有機化學(1002)

48). Which of the following is a suitable synthesis of *o*-methylphenol?



參考用

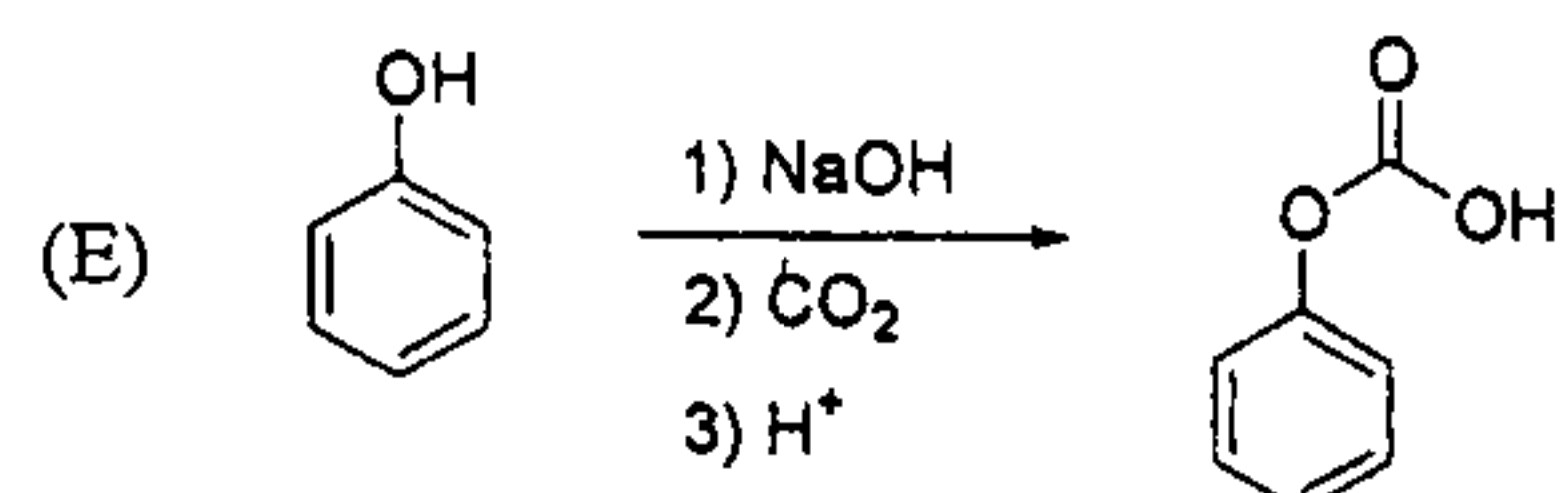
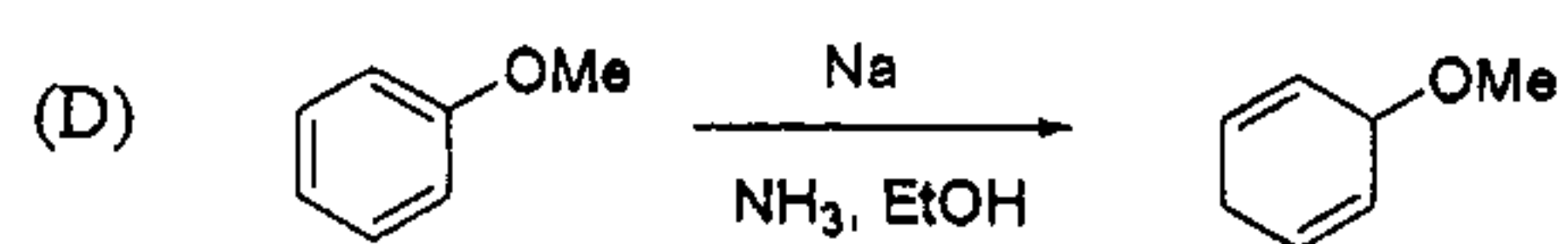
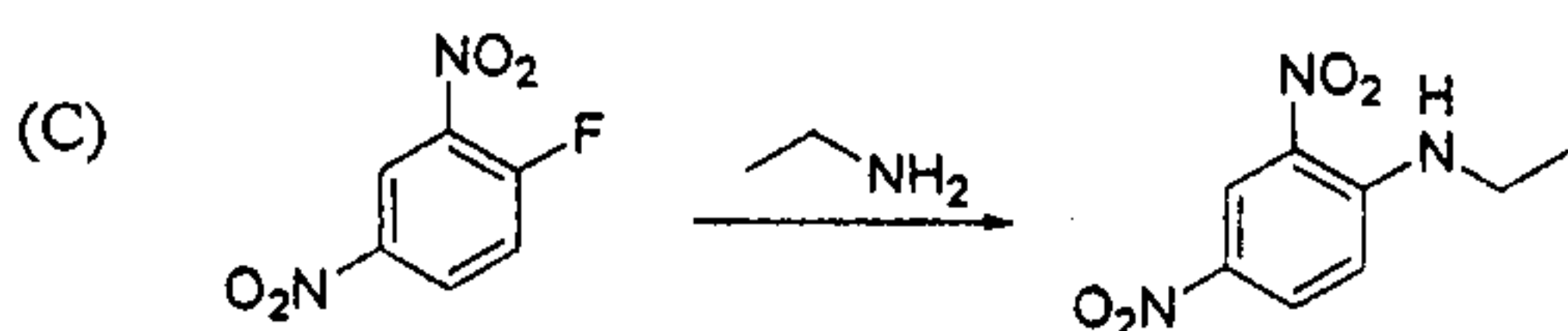
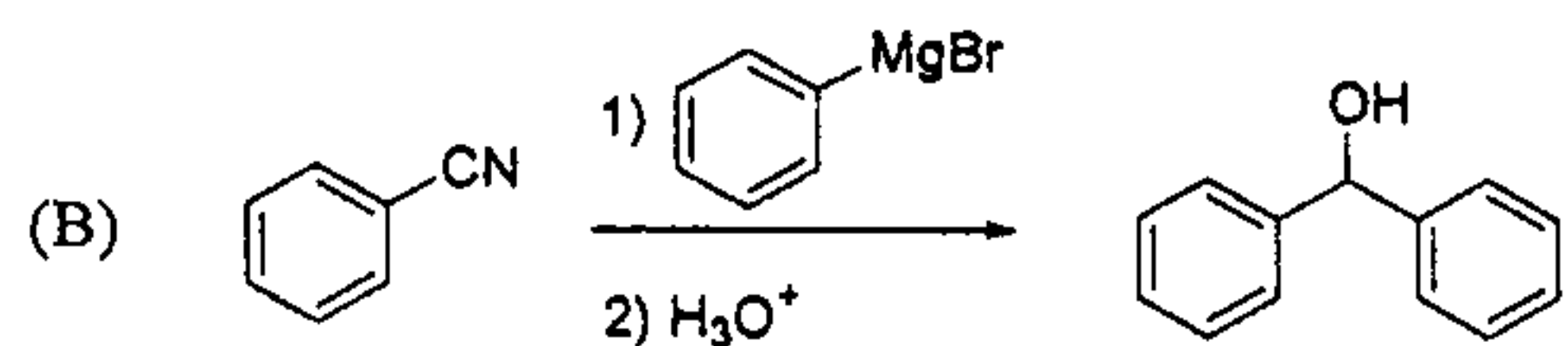
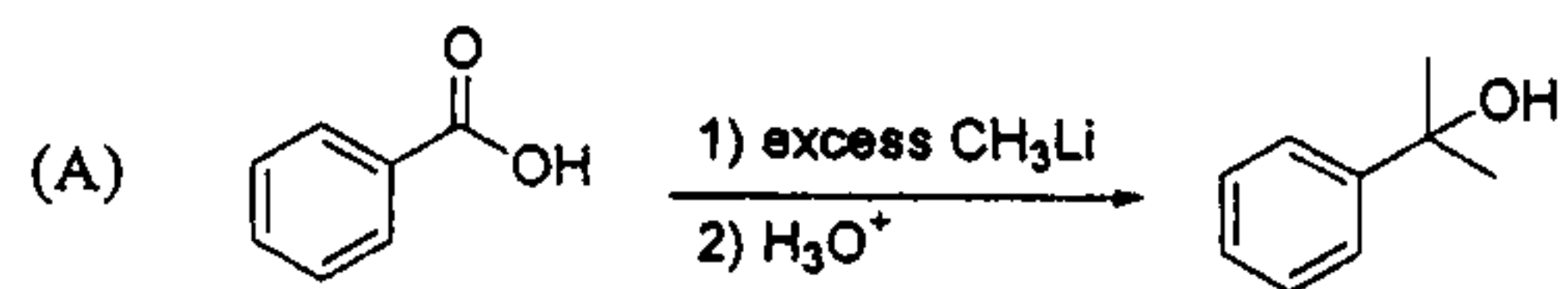
49). What is the correct product in the following reaction?



注意：背面有試題

科目：有機化學(1002)

50). Which of the following reactions gives the correct product?



參考用